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PM 2403

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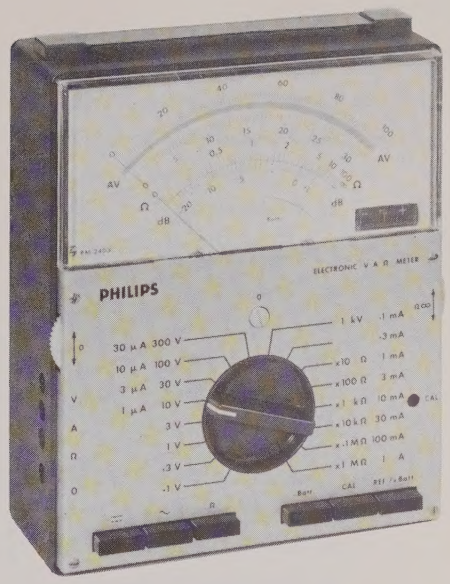
P.I.T.-SERVICE



ELECTRONIC VAΩ METER

PM 2403

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1/671/1/01

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I. GENERAL INFORMATION

A. PURPOSE

The PM 2403 is a transistorised multimeter with 48 measuring ranges and a FET-input.
The instrument can be used for measuring:
- direct and alternating voltages up to 1000 V (9 ranges)
- direct and alternating currents up to 1 A (12 ranges)
- resistance values up to 50 MΩ (6 ranges)

The kind of measurement (a.c. or d.c.) and, for direct voltage or current measurements, also the polarity is indicated automatically by an indicator.
The instrument can be used too as null indicator for d.c. measurements.
The built-in amplifier is powered by two 9-V-batteries.
An additional 1.5-V-battery is used for resistance measurements.
For data concerning operation refer to Directions for use.

B. TECHNICAL DATA

Properties expressed in numerical values with tolerances stated, are guaranteed. Values without statement of tolerances indicate the properties of an average instrument and merely serve for information.

Direct and alternating voltages

Measuring range	0.5 mV ... 1000 V 9 ranges 100 mV, 300 mV, 1 V, 3 V, 10 V, 30 V 100 V, 300 V and 1000 V (full-scale values)
Accuracy	≤ 3 % f.s.d.
Input impedance	100 mV : 20 MΩ // 30 pF 300 mV : 12 MΩ // 45 pF 1 V : 10.5 MΩ // 52 pF 3 V ... 300 V : 10 MΩ // 55 pF 1000 V : 10 MΩ
Frequency range	100 mV ... 300 V : 25 Hz ... 25 kHz (1000 V range is not frequency compensated)

Direct and alternating currents

Measuring range	50 nA ... 1 A 12 ranges 1 µA, 3 µA, 10 µA, 30 µA, 100 µA, 300 µA. 1 mA, 3 mA, 10 mA, 30 mA, 100 mA and 1 A (full-scale values)
Accuracy	≤ 3 % f.s.d.
Voltage loss	ranges 1 µA ... 100 mA: 100 mV range 1 A : 250 mV
Frequency range	1 µA ... 30 µA : 25 Hz ... 70 Hz 100 µA ... 30 mA : 25 Hz ... 25 kHz 100 mA and 1 A : 25 Hz ... 2 kHz

Resistance values

Measuring range

0 ... 50 MΩ
6 ranges
10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ and 1 MΩ
(centre-scale values)

Accuracy

±5 % (for centre-scale values)
The 10 Ω-range only meets this, with a new 1.5-V-battery

dB scale

Zero level

At 0.775 V (= 1 mV in 600 Ω)

dB	range
-40 ... -19	100 mV
-30 ... - 9	300 mV
-20 ... + 1	1 V
-10 ... +11	3 V
0 ... +21	10 V
+10 ... +31	30 V
+20 ... +41	100 V
+30 ... +51	300 V
+40 ... +61	1000 V

Power supply

for A, V measurements: 6 - 10 V (battery check possible)
2 x 9 V (e.g. Philips 6F - 22TR, 26 x 15 x 50 mm); for Ω measurements 1.5 V additional battery.
1 x 1.5 V (e.g. Philips R14TR, dia 26 mm, height 50 mm)

Power consumption

Average 2.5 mW

Working period

Minimum 1000 hours for voltage and current measurements.

Temperature range

-10 ... +45 °C

Calibration

With the aid of the battery voltage

Polarity indication

The polarity of the direct voltage or current is indicated by "+" or "-".
If alternating voltages or currents are measured, the indicator shows " ∼ ".
A meter deflection of 10 % causes full deflection of the indicator.

Use as null-indicator

Deflection visible from 5 mV

Mechanical data

Dimensions

height 80 mm
width 150 mm
length 185 mm

Weight

Approx. 1 kg (without batteries)

C. ACCESSORIES

Included in delivery

1 Set of measuring leads fitted with measuring pins PM 9050
1 Directions for use.

Optionally available

Ever-ready case PM 9055
Step-down transformer PM 9052
E.H.T. measuring probe PM 9240
D.C. current shunt (10 A and 30 A) PM 9242.

II. CIRCUIT DESCRIPTION

A. GENERAL

The measuring system consists of an amplifier preceded by attenuators for the various voltage, current and resistance ranges.

The amplifier is of the operational type, with two differential amplifier stages and a push-pull output stage.

The first stage comprises a selected pair of field-effect transistors, by which a high input impedance is obtained.

A high sensitivity of the moving coil system has been achieved by tautband suspension.

If sinusoidal currents or voltages are applied, the moving-coil instrument measures $\frac{1}{2}\sqrt{2} \times \hat{V}$ (= Vrms) of the signal with the aid of full wave rectifier GR3 ... GR6 and form-factor network R114/R115.

B. AMPLIFIER (Fig. 1)

The first differential stage of the amplifier, contains the selected f.e.t.-pair ON285 (TS1-TS2). Selection is necessary to achieve zero adjustment of the amplifier in a small range.

The current distribution between TS1 and TS2 can be adjusted with potentiometer R105 (zero), so that the output of the amplifier is zero.

The second differential stage (TS3-TS4) provides further amplification of the signal.

If a positive voltage is applied, the base voltage of TS5 will be positive too and the transistor will be conductive; TS6 will be cut off.

If a negative voltage is applied, TS5 will be cut off and TS6 will be conductive. Diode GR7 serves for an even change-over of the state of the transistors TS5 and TS6.

The feedback signal is applied to TS2.

To protect the amplifier against voltage overload, diodes GR1 and GR2 have been incorporated.

At overload, a point will be reached, where the amplifier is blocked and the voltage across R116 can no longer follow the input signal. Diode GR1 or GR2 will become conductive depending on the polarity of the input signal.

At an input voltage of e.g. 1000 V the voltage on the gate of TS1 cannot be larger than:

$$\frac{1000\ V}{R101} \times \{ R125 + R116 \,//\, (R117 + R118) \} + 0.6\ V = \text{approx. } 2\ V$$

This is far below the breakdown voltage of the used f.e.t.

The circuit is protected by a wire-fuse against current overloads.

C. ATTENUATORS

1. Measuring d.c. voltages (Fig. 2)

The input voltage is applied to the amplifier via a voltage divider.

In the 0.1 V range the divider consists of the resistors R26, R1, R124 and R100. The voltage across R100 (50 mV for f.s.d.) is amplified.

In the other ranges, resistors are connected in parallel with resistor R100. All resistors are dimensioned in such a way that full scale deflection is achieved when the voltage across the parallel circuit with R100 is 50 mV. Alternating voltages, superimposed on a direct voltage, are connected to earth via capacitors C1, C2 and C3.

2. Measuring a.c. voltages (Fig. 3)

The input voltage is applied to the amplifier via the voltage divider mentioned under point 1. A frequency-independent voltage division is obtained by C1-2-3 and C107 in conjunction with C4-5-6-7-8-9-10a and 10b, connected in parallel with R11 ... R17. Capacitor C100 blocks the d.c. component.

3. Measuring currents (Fig. 4 and Fig. 5)

If a current is applied, the voltage across R14 respectively R15 ... R25 is amplified. The current through the moving-coil system will be measured.
The input voltage of the amplifier (voltage across R14 ... R25), at a maximum current in every range, is 50 mV.

4. Measuring the resistances (Fig. 6)

For measuring resistances an additional 1.5 V battery is used.
By connecting a resistor to the input, a voltage divider is formed, consisting of the connected resistor and R2, or R2 in series with R3 ... R7, depending on the selected range. By varying potentiometer R9, the meter can be adjusted to $\Omega \infty$, so that the input voltage of the amplifier is again 50 mV.

D. REF/+Batt., CAL and -Batt

1. REF/+Batt. (Fig. 7)

If push-button "REF/+Batt." is depressed, the voltage of the +9 V-battery is directly measured, without amplifier.
As a result an indication is obtained, serving as a reference for calibrating the amplifier.

2. CAL. (Fig. 8)

If push-button "CAL" is depressed, the positive supply voltage is measured via a voltage divider (R122 and R121). The voltage across R121 is amplified and with the aid of potentiometer R118 (CAL), the amplifier may be calibrated.
The measuring instrument has to be adjusted to the value, which has been measured in position "REF/+Batt.".
The polarity indicator indicates "+".

3. -Batt. (Fig. 9)

If push-button "-Batt." is depressed, the negative supply voltage is measured via voltage divider R122/R121.
The voltage across R121, which is negative with respect to earth, is amplified. The measuring instrument indicates the battery voltage and the polarity indicator indicates "-".

E. POLARITY INDICATION

If a voltage or current, which is positive with respect to earth, is applied to input socket V or A, the output voltage of the amplifier is also positive with respect to earth. The polarity indicator gives a positive indication.
If a negative voltage or current is applied, the output voltage of the amplifier will be negative, then the current through the polarity indicator reverses and the indicator gives a negative indication.
If an alternating voltage or current is applied, the average voltage across the indicator will be zero and the pointer will remain in the mid-position.

III. GAINING ACCESS TO THE PARTS

A. REMOVING THE TEXT PLATE (Fig. 10)

The text plate can be taken off after removing four screws "A".

B. REMOVING THUMB WHEELS " ↕ 0" and "Ω∞↕ " (Fig. 11)

- Remove the text plate (see A).
- Now knobs B and C can be pushed off the shaft.

C. REMOVING THE HOUSING

- Remove the two screws of the battery compartment
- Remove the screws, visible now in the two holes below the lid of the battery compartment
- Pull the housing on the top a little upwards, slide it off the frame and lift it off the instrument

D. REMOVING PRINTED WIRING BOARD U_A (Fig. 12)

- Remove the housing (see C)
- Remove the nuts D
- Lift print U_A and hinge it down

E. REMOVING PRINTED WIRING BOARD U_B (Fig. 12)

- Remove the text plate (see A)
- Remove the plastic caps of the push-buttons SK2 and SK7
- Remove the housing (see C)
- Remove the printed wiring-board U_A (see D)
- Remove screws E
- The printed wiring board can be removed now in vertical direction

Remark: The nuts of screws E are not locked.

F. REMOVING PRINTED-WIRING BOARD U_C (Fig. 13)

- Remove the housing (see C)
- Remove printed-wiring board U_A (see D)
- Remove the aluminium screening plate
- Unsolder resistor R26
- The socket block can be taken out
- Printed-wiring board U_C can be slid out

IV. REPLACING PARTS

The operations below should be carried out in dust-free and well-lit surroundings.

A. MEASURING SYSTEM (Fig. 11)

- Take the batteries out of the battery compartment
- Slacken the screws in the battery compartment and slide the locking plates of the transparent window inwards
- Remove the text plate (III A)
- Remove the screws F
- Remove the transparent window

Do not touch the inside of the transparent window because it has been treated with an anti-static liquid. If the window is touched, it may loose its anti-static properties and, moreover, become stained.

- Remove screws G
- Scale, magnet and moving coil system can then be carefully lifted from the instrument as one unit
- Place the measuring system in vertical position, diagonally across the recess in the frame
- Unsolder the connection wires
- Check the new system in accordance with point V
- Solder the wires in their proper positions and refit the system with scale
- Refit the transparent window
- Refit the text plate
- Lock the transparent window and fasten the screws again
- Fit the batteries
- Check the instrument in accordance with V A, B and D

Remark: Pay attention to the rubber rings, fitted in the recesses on the top of the frame, upon which the scale plate supports.

B. POLARITY INDICATOR

- Remove the text plate (III A)
- Remove the complete measuring system with scale
- Take the polarity indicator out of the recess and unsolder the connection wires
- Check the new indicator: connect the "+" terminal of the indicator to the positive pole and the "-" terminal to the negative pole of a 1.5-V-battery. Connect a resistor of approx. 30 kΩ in series with the indicator to limit the current. The indicator should deflect to the right (+).
  Reverse the polarity of the 1.5-V-battery.
  The indicator should deflect to the left (-).
- Solder the connection wires in their proper positions
- Refit the indicator
- Fit the measuring system
- Check the instrument in accordance with point V A and C

C. RESISTORS AND CAPACITORS

1. Resistors

No adjustments are necessary, exept after replacement of R9 (see V A), R105 (see V A), R118 (see V A and B) and R120 (see V D).

2. Capacitors

No adjustments are necessary, exept after replacement of capacitors C1, C2, C3 and C107 (see V E).

The tolerances stated in the list of electrical parts, however, should be observed.

D. DIODES AND TRANSISTORS

1. Diodes

No adjustments are necessary after replacement of diodes.

2. Transistors

After replacement of TS1 + TS2, check and adjust the instrument in accordance with chapter V A and B.

E. RANGE SELECTOR KNOB (Fig. 11)

- Set the range selector switch in position "1 kV" (as reference)
- Remove the text plate (III A)
- Carefully pull the knob out of the instrument. The knob contains two leaf springs, which clamp themselves into the recess of the knob
- Replace knob or springs
- Fit the knob by pressing it in the proper position onto the spindle
- Check the instrument in accordance with chapter V A, B and C

F. RANGE-SELECTOR ASSEMBLY

- Remove the text plate (III A)
- Remove the range selector knob (see E)
- Remove the nuts K (Fig. 11)
- Remove the housing (III C)
- Remove printed-wiring board U_A (III D)
- Remove the aluminium screening plate
- Unsolder the connection wires on the range selector
- The assembly can be taken out
- Check, and if necessary, replace the assembly
- Refit the screening plate
- Fit printed-wiring board U_A
- Fit the housing
- Turn the instrument face up
- Refit the range selector knob
- Refit the text plate
- Check the instrument in accordance with point V A, B and C

G. PUSH-BUTTON ASSEMBLY

1. Assembly

- Remove the housing (III C)
- Unsolder the connection wires from printed-wiring board U_B
- Remove printed-wiring board U_B
- Replace board U_B and fit the instrument
- Check the instrument according to V A, B, C and E

2. Push-button switches

- Remove the housing (III C)
- Unsolder the connection wires from printed-wiring board U_B
- Remove printed-wiring board U_B
- Cut off the pins of the defective switch
- Disconnect the switch by bending the lugs of the rail straight
- Remove the pins from the printed-wiring board with the aid of a soldering iron
- Mount the new switch
- Fit printed-wiring board U_B
- Solder the connection wires in their proper positions
- Fit the housing
- Check the instrument in accordance with V A, B, C and E

H. PRINTED-WIRING BOARDS (Fig. 12)

1. Printed-wiring board U_A

- Remove printed-wiring board U_A
- Replace the board and fit the instrument
- Check the instrument in accordance with V A, B, D and E

2. Printed-wiring board U_B

Printed-wiring board U_B contains the push-button assembly.
For replacement see IV G.

J. BATTERY CONTACTS

1. 1.5 V Battery

- Remove the 1.5 V battery (right-hand side compartment)
- Remove the measuring system (IV A) so that the soldering lugs become accessible
- Unsolder the connection wire of the defective plate
- Straighten the soldering lug
- Slide the plate out of the slot at the rear. The plate can then be repaired easily or, if necessary, completely replaced
- Slide the plate back into the slot
- Bend the lugs and solder the connection wire in its proper position
- Fit the measuring system
- Fit the transparent window and the text plate
- Fit the housing
- Check the instrument according to V A, B and C

2. 9 V Batteries

- Take the 9 V batteries out of the left-hand side compartment
- Remove the defective battery connection plate from the battery
- Pull the plastic cap from the connection plate
- Unsolder the connection wires
- For the positive supply, solder the connection wire, connected to push-button SK7 point 2, to the positive connector of the battery and the earth lead to the other.
  For the negative supply, solder the connection wire, connected to push-button SK7 point 10, to the negative connector of the battery and the earth lead to the positive connector.

- Clip the battery connection plate on the battery again
- Put the batteries in the compartment
- Fit the cover of the battery compartment
- Check the instrument according to V A and C

K. BATTERIES

1. 1.5 V Battery

- Remove the cover of the battery compartment and take out the old battery (right-hand side compartment)
- First push the bottom side of the new battery against the spiral spring and then slide the positive pole into the battery compartment.
  The construction of the battery compartment is such, that the battery can make contact in the correct position only. The polarity is indicated on the text plate at the rear.
- Fit the cover

2. 9 V Battery

- Remove the cover of the battery compartment and take out the batteries (left-hand side compartment)
- Clip the battery connection plates on the new batteries and put them in the compartment again
- Fit the cover
- Check the instrument according to V C

L. GRIP

- Remove the housing
- Turn the housing with the back down
- Straighten the upper lugs of the grip retainers
- Grip retainers and retaining springs can be removed
- Exchange both grip retainers (right-hand side retainer becomes left-hand side retainer and left-hand side retainer becomes right-hand side retainer) and position the new grip
- Fit the retaining springs
- Push the lower lugs downwards

M. RUBBER STUDS

- Remove the housing from the instrument
- Insert the new studs through the openings of the rear of the housing from the inside (point outwards)
- Pull the rubber stud tightly against the panel and cut off the excess material

N. TEXT PLATE AT THE REAR

- Remove the housing (III C)
- Remove the rubber studs and text plate
- Fit the new text plate by inserting new rubber studs (see IV. M)

O. RESISTORS R2, R3, R4 and R5 (Fig. 12)

The measuring circuit for resistance measurements has not been protected against external voltages, which might damage some components, especially resistors R2 up to R6.
Therefore spare resistors, which may be used for replacement of a defective resistor, have been fitted on to the same plate.

- Remove the housing (III C)
- Slide out plate M in vertical direction
- Replace defective resistor(s)
- Fit the plate
- Fit the housing
- Check the instrument according to V A

P. HOLDER WITH FUSE-WIRE

- Remove the cover of the battery compartment
- Remove the small cover over the holder, located between the two battery compartments
- Replace the holder by a new one with fuse wire
- Pull a piece of wire from the holder and clamp it under the two screws N
- Fit the covers

V. CHECKING AND ADJUSTING

A. ZERO SETTING

1. Mechanical

- Instrument switched off
- If necessary set the pointer to "0" with the aid of the correction screw at the front (Fig. 10, item 5)

2. Electrical

- Depress push-button "⎓"
- Adjust the polarity indicator with the aid of potentiometer R107 (wheel ↕ 0) to mid-position
- Depress push-button "Ω"
- Adjust the pointer to Ω ∞ by means of potentiometer R9 (wheel Ω∞ ↕)

B. CALIBRATION

- Carry out zero setting (V A)
- Depress push-button "⎓" (SK2)
- Depress push-button "REF./+Batt." (SK7)
- Note the indicated value (X)
- Depress push-button "CAL" (SK6)
- Adjust the indication to value X with the aid of potentiometer "CAL" (R118) at the front of the instrument (Fig. 10)

C. BATTERY CHECK

- Carry out zero setting (V A) and calibration (V B)
- Depress push-button "-Batt." (SK5). The meter indicates the voltage of the battery for the negative supply. The polarity indicator shows "-".
- Depress push-button "REF./+Batt." (SK7). The meter indicates the voltage of the battery for the positive supply. The polarity indicator is in the mid-position, because it is short-circuited now.
- Both readings should lie in the "Batt." region (lower scale).
  If necessary, replace the 9 V batteries (see IV.K)

Remark: Battery check of the 1.5 V battery is not possible. Replacement is necessary if the pointer cannot be adjusted to ∞ (Ω scale).

D. MEASURING SYSTEM

1. Sensitivity

Method A (with galvanometer)

- Set the meter to zero mechanically
- Connect a galvanometer in series with the meter system
- Apply a direct current of 50 μA to this circuit
- The meter must show full scale deflection, tolerance 5 %

Method B (if no galvanometer is available)

- Set the meter to zero mechanically
- Connect a decade resistance box in series with the meter system
- Adjust the resistance box to such a high a value that the resistance of the system (from 2 to 3 kΩ) is low in comparison with that of the box.
- Apply a variable direct voltage to the above mentioned circuit
- Adjust this voltage to such a value that full scale deflection is obtained and measure the voltage across the resistance box with an accurate D.C. voltmeter (tolerance 0.5 %)
- The current can be calculated by dividing voltage and resistance of the resistance box
- The result should be 50 μA, tolerance 5 %

2. If the measuring system is replaced, the sensitivity of the amplifier has to be adapted with potentiometer R118 (CAL) and R120.

Adjustment

- Depress push-button "⎓"
- Set the range selector in position 1 V
- Apply a d.c. voltage of 1 V ± 0.5 %
- Adjust the meter with the aid of potentiometer R118 (CAL) to full scale deflection
- Depress push-button "CAL"
- Note the value indicated (value X)
- Depress push-button "REF./+Batt."
- Replace R120 by a resistance box (100 kΩ, ≤ 0.5 %)
- Adjust the meter to the value X, with the aid of the resistance box (value between 4.42 kΩ and 28.7 kΩ)
- Fit the found resistance value ± 1 % in the place of the resistance box

E. TRIMMERS C3 AND C107

The RC-time of the input attenuator should be equal to that of the amplifier. This is effected with the aid of C3 and C107, so that frequency independant voltage division is achieved.

Adjustment

- Carry out zero setting (V A)
- Depress push-button "~"
- Set the range selector to position 100 V
- Apply an a.c. voltage 100 V, 1 %, 10 kHz
- Adjust the meter with the aid of trimmer C3 to full scale deflection
- Apply an a.c. voltage of 0.1 V, 1 %, 10 kHz
- Set the range selector to position 0.1 V
- Adjust the meter to full scale deflection with the aid of trimmer C107

Remark: This adjustment should be effected with the instrument in the housing which has a certain capacitance with respect to earth.

VI. ANTI-STATIC TREATMENT

The transparent window of the instrument is coated on the inside with a colourless liquid with anti-static properties in order to eliminate static charges which might affect the deflection of the pointer and attract dust.

This side should never be rubbed with a cloth or similar material as this would cause the window to become dull, and the anti-static effect would be lost. The windows supplied by Service do not posses this anti-static coating. The liquid required to make a window anti-static is supplied separately; for the code number, reference is made to the list of mechanical parts.

To avoid blotches and stripe the following applies:

- Use a little anti-static liquid
- Spread the liquid with a brush and rub it firmly on the window as if it were applied to a porous surface
- Breath on the treated surface as is done with spectacle glasses before cleaning

VII. LIST OF PARTS

A. MECHANICAL

Item	Fig.	Qty.	Ordering number	Description
1	10	1	5322 347 10061	Polarity indicator
2	10	1	5322 693 90256	Housing
3	10	2	5322 498 70038	Grip retainer
4	10	1	5322 498 30052	Grip
5	10	1	5322 535 40023	Correction screw
6	10	1	5322 413 50742	Range selector knob
7	10	1	5322 455 90377	Text plate (front)
8	10	6	5322 410 21046	Plastic cap for push-button
9	11	1	5322 344 50033	Measuring system complete with magnet and scale
10	11	2	5322 413 40483	Thumb wheel
11	13	1	5322 290 80212	Battery contact with spring
12	13	1	5322 290 80213	Battery contact
13	13	1	5322 115 90076	Coil former with fuse wire
14	13	2	4822 290 80013	Battery contact
15	13	1	5322 273 30219	Segment switch SK1/II
16	13	1	5322 413 70069	Cover for measuring system
17	14	1	5322 693 90111	Transparent window
18	14	1	5322 278 60056	Frame + segment SK1/II
19	14	1	5322 290 60158	Contact block with 4 sockets
20	14	6	5322 276 10368	Push-button
21	14	1	5322 693 90255	Frame
22	_	1	5322 455 90378	Text plate (rear)
23	_	4	5322 462 40109	Rubber foot
24	-	1	5322 693 90253	Cover battery compartment
25	-	30cc	4822 230 80021	Bottle with anti-static liquid

B. ELECTRICAL

No.	Value	Tol.	Ordering number	Description
R1	10 MΩ	1 %	5322 111 40189	Carbon
R2	9.09 Ω	1 %	5322 116 50863	Metal film
R3	90.0 Ω	1 %	5322 116 50793	Metal film
R4	909 Ω	1 %	5322 116 50765	Metal film
R5	9.09 kΩ	1 %	5322 116 50537	Metal film
R6	90.9 kΩ	0.25 %	5322 116 50859	Metal film
R7	1 MΩ	1 %	5322 111 20317	Carbon
R8	10 MΩ	10 %	5322 111 30342	Carbon
R9	470 kΩ	-	5322 101 20368	Potentiometer
R10	120 kΩ	5 %	4822 110 61163	Carbon
R11a	2.2 MΩ	1 %	5322 111 20318	Carbon
R11b	120 kΩ	5 %	4822 110 61163	Carbon
R12a	510 kΩ	1 %	5322 116 50334	Carbon
R12b	46.4 kΩ	1 %	5322 116 50557	Metal film
R13a	162 kΩ	1 %	5322 116 50813	Metal film
R13b	1.5 kΩ	5 %	4822 110 61112	Carbon
R14a	49.9 kΩ	1 %	5322 116 50674	Metal film
R14b	330 Ω	5 %	4822 110 61094	Carbon
R15a	15.8 kΩ	0.25 %	5322 116 50857	Metal film
R15b	100 Ω	5 %	4822 110 61081	Carbon
R16	4.99 kΩ	1 %	5322 116 50523	Metal film
R17	1.58 kΩ	1 %	5322 116 50622	Metal film
R18	499 Ω	1 %	5322 116 50847	Metal film
R19	158 Ω	1 %	5322 116 50836	Metal film
R20	49.9 Ω	1 %	5322 116 50173	Metal film
R21	15.8 Ω	1 %	5322 116 50861	Metal film
R22	4.99 Ω	1 %	5322 116 50568	Metal film
R23	1.58 Ω	1 %	5322 116 50862	Metal film
R24, R25	500 mΩ+50 mΩ	-	5322 115 80097	Shunt
R26	10 kΩ	5 %	4822 110 60134	Carbon
R100	10 MΩ	1 %	5322 111 53189	Carbon
R101	1.5 MΩ	10 %	4822 111 30077	Carbon
R102	1 kΩ	5 %	4822 110 60107	Carbon
R103	33 kΩ	5 %	4822 110 60147	Carbon
R104	33 kΩ	5 %	4822 110 60147	Carbon
R105	1 kΩ	-	5322 101 20367	Potentiometer
R106	220 Ω	5 %	4822 110 61089	Carbon
R107	47 kΩ	5 %	4822 110 61152	Carbon
R108	180 kΩ	5 %	4822 110 60167	Carbon
R109	18 kΩ	5 %	4822 110 61141	Carbon

No.	Value	Tol.	Ordering number	Description
R110	100 kΩ	5 %	4822 110 61161	Carbon
R111	22 kΩ	5 %	4822 110 61143	Carbon
R112	22 kΩ	5 %	4822 110 61143	Carbon
R113	22 kΩ	5 %	4822 110 61143	Carbon
R114	30 kΩ	1 %	5322 116 50121	Carbon
R115	270 kΩ	1 %	5322 116 50531	Carbon
R116	1.47 kΩ	1 %	5322 116 50635	Metal film
R117	2.74 kΩ	1 %	5322 116 50636	Metal film
R118	1 kΩ		5322 101 20242	Potentiometer
R119	187 kΩ	1 %	4822 116 50128	Metal film
R121	487 Ω	1 %	5322 116 50659	Metal film
R122	100 kΩ	1 %	5322 116 50244	Metal film
R123	18 kΩ	5 %	4822 110 61136	Carbon
R124	22 kΩ	5 %	4822 110 61143	Carbon
R125	1 kΩ	5 %	4822 110 61107	Carbon
R126	1 kΩ	5 %	4822 110 61107	Carbon
R127	100 Ω	5 %	4822 110 60081	Carbon

Capacitors

No.	Value	Voltage	Tol.	Ordering number	Description
C1	100 pF	500 V	2 %	4822 122 10092	Ceramic
C2	100 pF	500 V	2 %	4822 122 10092	Ceramic
C3	6 pF			5322 125 60069	Trimmer
C4	215 pF	125 V	1 %	4822 425 42151	Micropoco
C5	887 pF	63 V	1 %	5322 121 50484	Micropoco
C6	3.01 nF	63 V	1 %	5322 121 50483	Micropoco
C7	10 nF	63 V	1 %	5322 121 50097	Minipoco
C8	31.6 nF	63 V	1 %	5322 121 50486	Minipoco
C9	100 nF	63 V	1 %	5322 121 50425	Minipoco
C10a	158 nF	63 V	1 %	5322 121 50485	Minipoco
C10b	158 nF	63 V	1 %	5322 121 50485	Minipoco
C11	220 nF	100 V	10 %	4822 121 40194	Mepolesco
C100	6.8 nF	500 V	-20/+50 %	4822 120 11129	Ceramic
C101	15 nF	250 V	10 %	4822 121 40049	Nugget
C102	15 nF	250 V	10 %	4822 121 40049	Nugget
C103	10 nF	250 V	10 %	4822 121 40047	Nugget
C104	220 nF	250 V	10 %	4822 121 40079	Nugget
C105	220 nF	250 V	10 %	4822 121 40079	Nugget
C106	1 μF	100 V	10 %	5322 121 40176	Mepolesco
C107	20 pF	-	-	4822 125 50045	Trimmer
C108	100 pF	500 V	5 %	4822 120 11081	Ceramic
C113	4.7 nF	500 V	-20/+50 %	4822 120 10125	Ceramic

C. MISCELLANEOUS

No.	Ordering number	Description
U_A	5322 216 70134	Printed-wiring board with components
U_B	5322 216 70135	Printed-wiring board with push-button switches
U_C	5322 216 70133	Printed-wiring board with components
TS1 TS2	5322 130 40702	Dual f.e.t. ON285
TS3	5322 130 40324	Silicon transistor
TS4	5322 130 40324	Silicon transistor
TS5	5322 130 40325	Silicon transistor
TS6	5322 130 40324	Silicon transistor
GR1 ... GR7	4822 130 40182	Silicon diode

PM 9240

A. GENERAL

The probe PM 9240 has been designed for measuring direct voltages up to 30 kV in combination with the PM 2403.
The high-ohmic resistor in the probe (990 MΩ) forms a voltage divider with the input resistance (10 MΩ) of the PM 2403.

B. TECHNICAL DATA

Inaccuracy	: 10 % (error PM 2403 included)
Attenuation	: 100 x (in combination with PM 2403)
Maximum permissible input voltage	: 30 kV
Input impedance	: approx. 1000 MΩ
Current consumption	: 30 μA at 30 kV; further proportional to voltage
Stability	: better than 10 %
Dimensions	: length 250 mm diameter 25 mm (safety ring 40 mm)
Weight	: 200 g

C. USE

- Check the zero setting and the calibration of the PM 2403
- Connect the 4 mm plugs of the probe to sockets "0" and "V" of the PM 2403 and the earthing-clip to a proper earth lead
- In position "300 V" max. 30 kV can then be measured, in position "100 V" max. 10 kV and in position "30 V" max. 3 kV

D. DISMANTLING

- Unscrew safety ring
- Remove the insulating tube (grip)
- All parts are then accessible

E. LIST OF PARTS

Pos.	Fig.	Qty.	Ordering number	Description
1	18	1	5322 268 10003	Test prod
2	18	1	5322 447 60026	Insulating tube
3	18	1.5 m	4822 322 10006	Cable (black)
4	18	1 m	4822 323 20046	Cable (for earth connection)
5	18	1	4822 290 40042	Earthing clip
6	18	1	4822 264 30034	4-mm plug red
7	18	1	4822 264 30033	4-mm plug black
R1	18	1	5322 111 70039	Resistor 990 MΩ, 5 W, ± 5 %

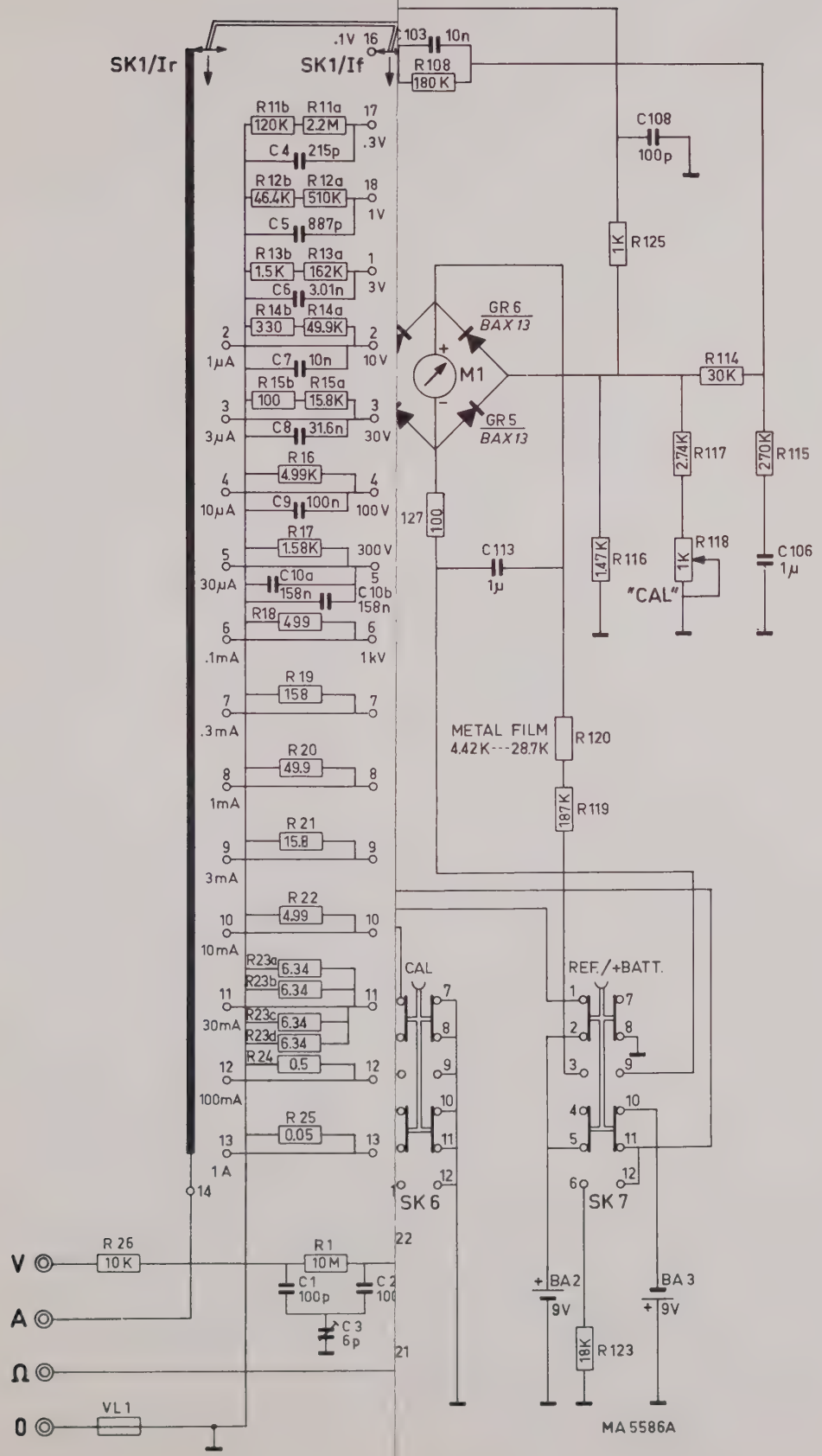

SK1/Ir
SK1/If
.1V 16
103 10n
R108 180K
R11b 120K
R11a 2.2M
17 .3V
C4 215p
R12b 46.4K
R12a 510K
18 1V
C5 887p
R13b 1.5K
R13a 162K
1 3V
C6 3.01n
R14b 330
R14a 49.9K
2 10V
1µA
C7 10n
R15b 100
R15a 15.8K
3 30V
3µA
C8 31.6n
R16 4.99K
4 100V
10µA
C9 100n
R17 1.58K
300V
5
30µA
C10a 158n
C10b 158n
R18 4.99
6 1kV
.1mA
R19 158
7
.3mA
R20 49.9
8
1mA
R21 15.8
9
3mA
R22 4.99
10
10mA
R23a 6.34
R23b 6.34
11
R23c 6.34
R23d 6.34
30mA
R24 0.5
12
100mA
R25 0.05
13
1A
14
GR6 BAX13
GR5 BAX13
M1
127 100
C113 1µ
C108 100p
1K R125
R114 30K
2.74K R117
270K R115
1.47K R116
1K R118
"CAL"
C106 1µ
METAL FILM 4.42K---28.7K R120
187K R119
CAL
REF./+BATT.
SK6
SK7
V
A
Ω
0
R26 10K
R1 10M
C1 100p
C3 6p
VL1
22
21
+ BA2 9V
BA3 + 9V
18K R123
MA 5586A

Fig./Abb. 1

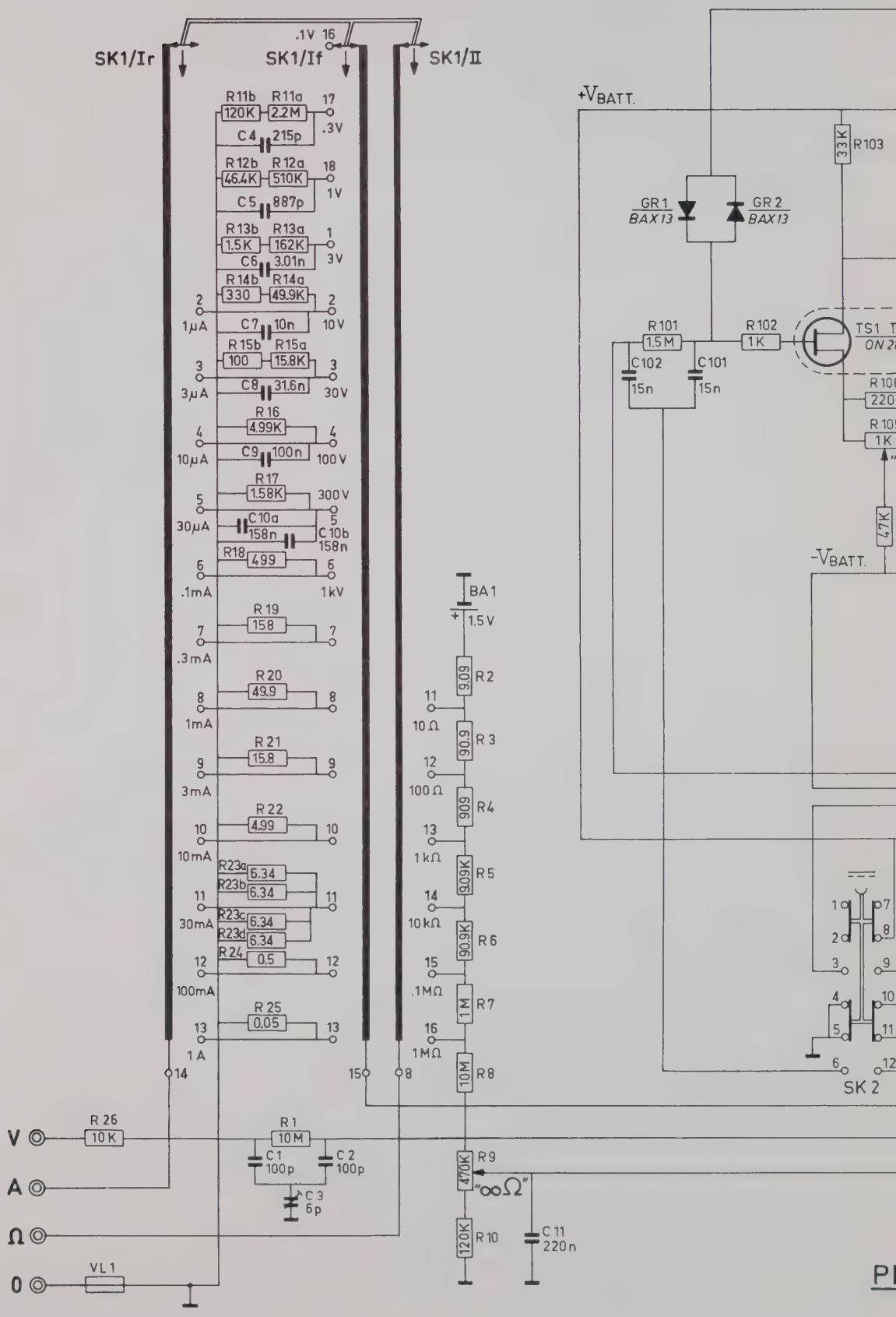
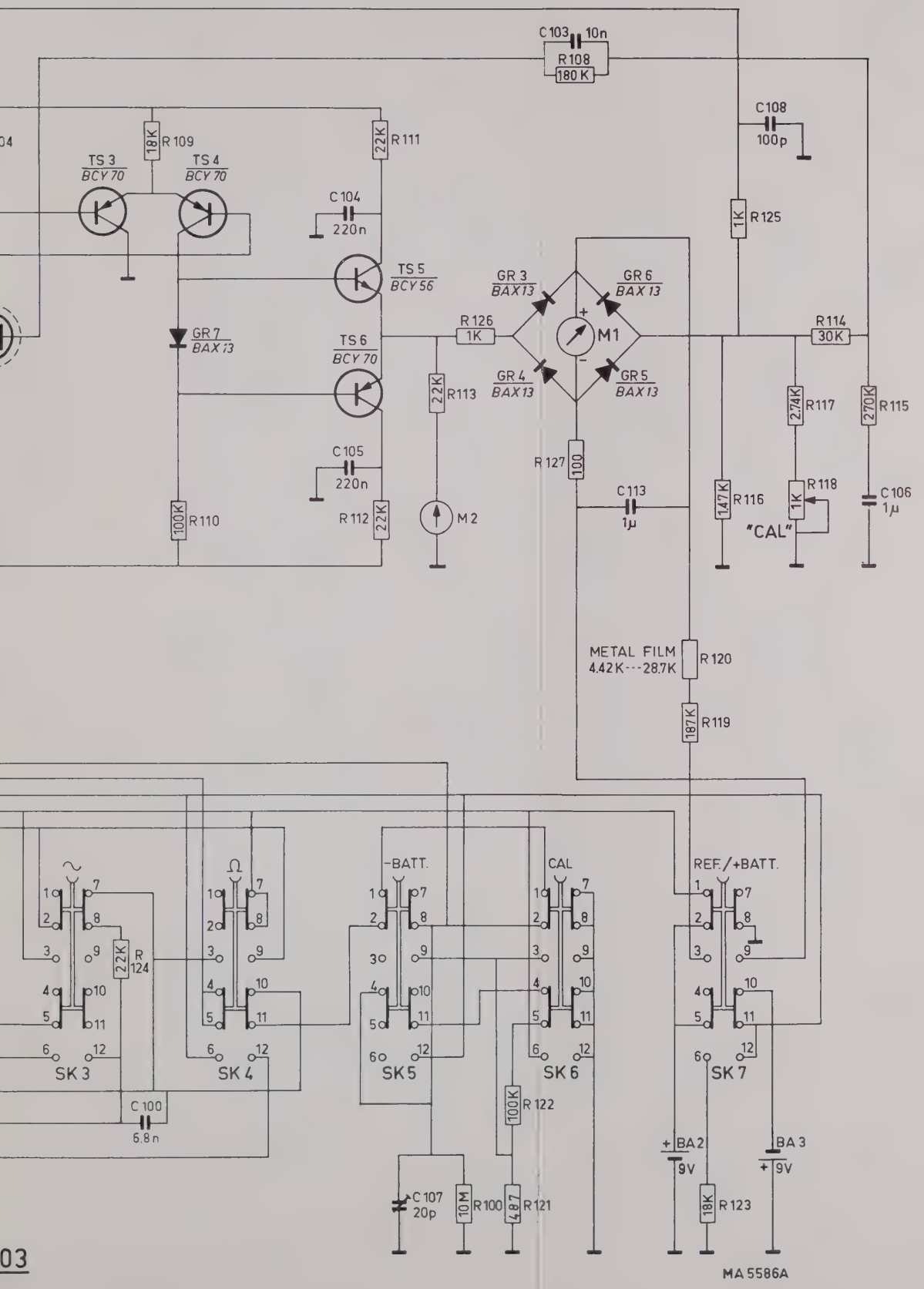

SK1/Ir
SK1/If
SK1/II
.1V 16
R11b 120K
R11a 2.2M
17
.3V
C4 215p
R12b 46.4K
R12a 510K
18
1V
C5 887p
R13b 1.5K
R13a 162K
1
3V
C6 3.01n
R14b 330
R14a 49.9K
2
1µA
C7 10n
10V
R15b 100
R15a 15.8K
3
3µA
C8 31.6n
30V
R16 4.99K
4
10µA
C9 100n
100V
R17 1.58K
300V
5
30µA
C10a 158n
C10b 158n
R18 499
6
.1mA
1kV
R19 158
7
.3mA
R20 49.9
8
1mA
R21 15.8
9
3mA
R22 4.99
10
10mA
R23a 6.34
R23b 6.34
11
30mA
R23c 6.34
R23d 6.34
R24 0.5
12
100mA
R25 0.05
13
1A
14
15
8
BA1
1.5V
R2 9.09
11
10Ω
R3 90.9
12
100Ω
R4 909
13
1kΩ
R5 9.09K
14
10kΩ
R6 90.9K
15
.1MΩ
R7 1M
16
1MΩ
R8 10M
+VBATT.
-VBATT.
R103 33K
GR1 BAX13
GR2 BAX13
R101 1.5M
R102 1K
C102 15n
C101 15n
TS1
ON2
R10
220
R10
1K
47K
SK2
V
A
Ω
0
R26 10K
R1 10M
C1 100p
C2 100p
C3 6p
R9 470K
"∞Ω"
R10 120K
C11 220n
VL1

Fig. /Abb. 1


C103 10n
R108 180K
C108 100p
R109 18K
R111 22K
TS3 BCY70
TS4 BCY70
C104 220n
TS5 BCY56
R125 1K
GR3 BAX13
GR6 BAX13
M1
R126 1K
R114 30K
GR7 BAX13
TS6 BCY70
GR4 BAX13
GR5 BAX13
R113 22K
R117 274K
R115 270K
R127 100
C105 220n
C113 1µ
R116 147K
R118 1K
C106 1µ
"CAL"
R110 100K
R112 22K
M2
METAL FILM 4.42K---28.7K
R120
R119 187K
-BATT.
CAL
REF./+BATT.
SK3
SK4
SK5
SK6
SK7
R 124 22K
C100 6.8n
R122 100K
C107 20p
R100 10M
R121 48.7
BA2 9V
BA3 9V
R123 18K
MA 5586A

03

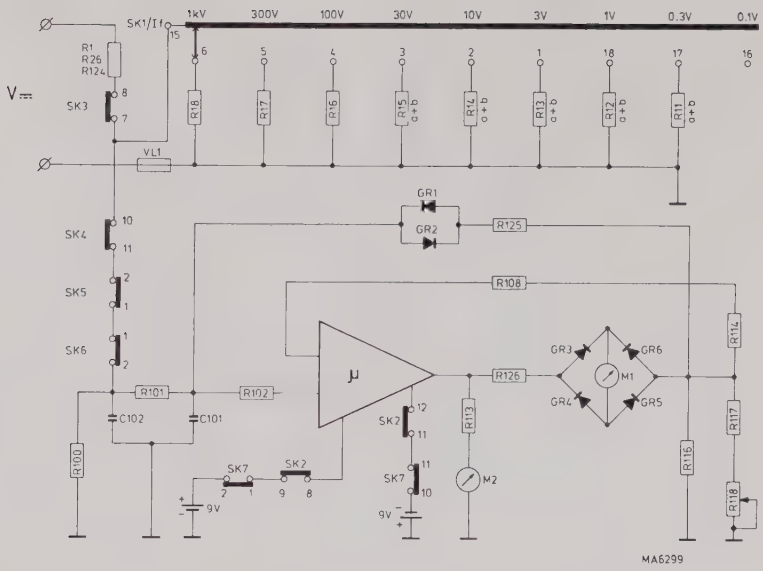


Fig. /Abb. 2

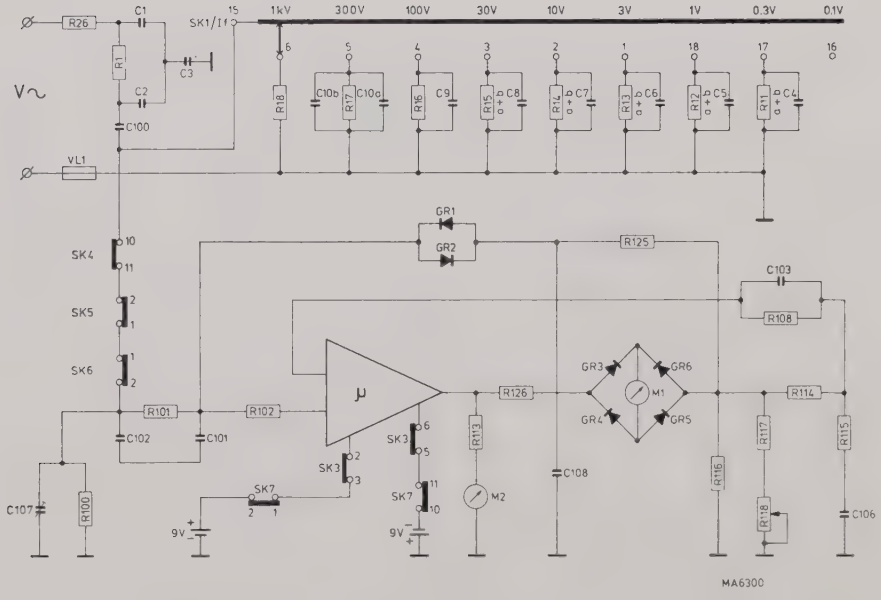


Fig. /Abb. 3

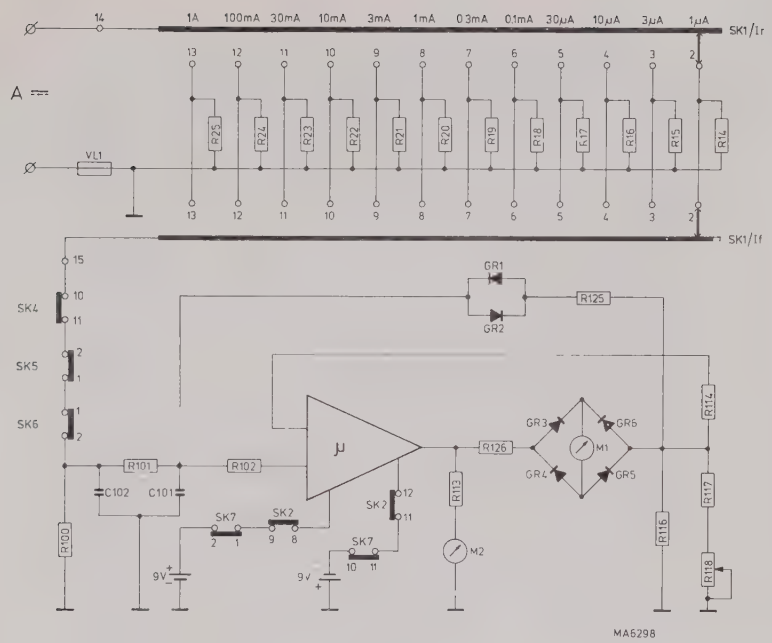


Fig. /Abb. 4

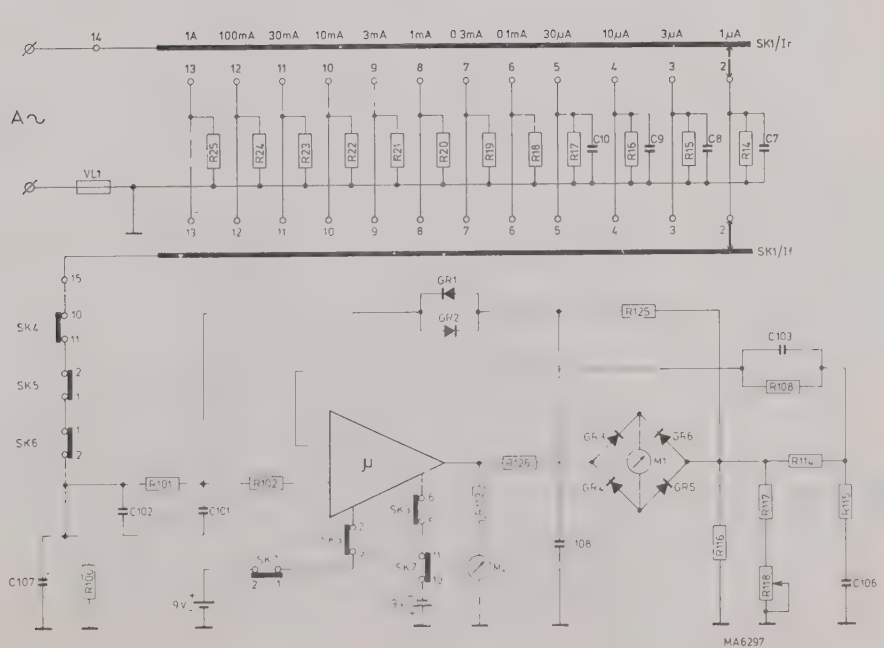


Fig. /Abb. 5

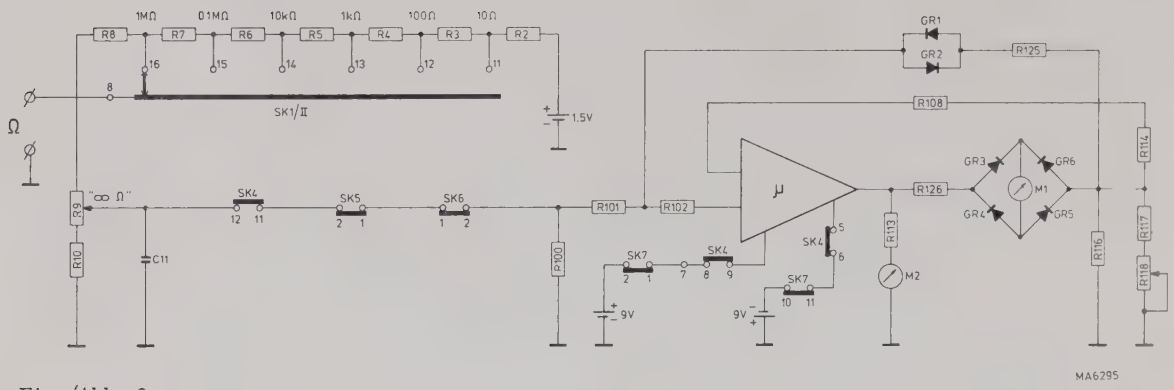
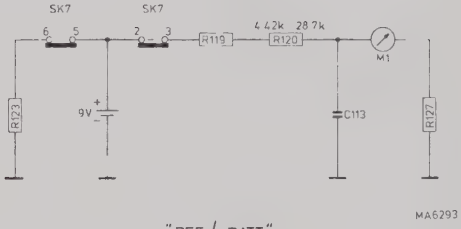


Fig. /Abb. 6



"REF./+BATT"

Fig. /Abb. 7

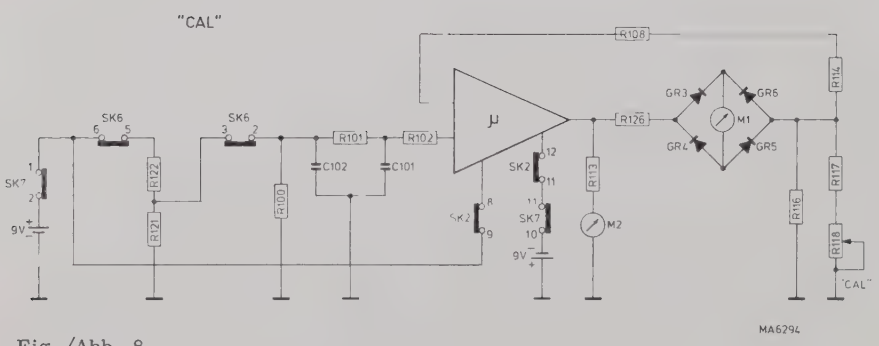


Fig. /Abb. 8

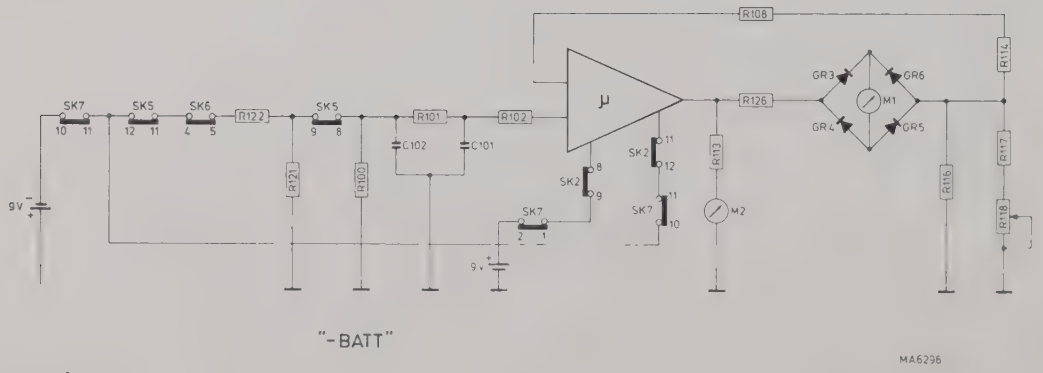


Fig. /Abb. 9

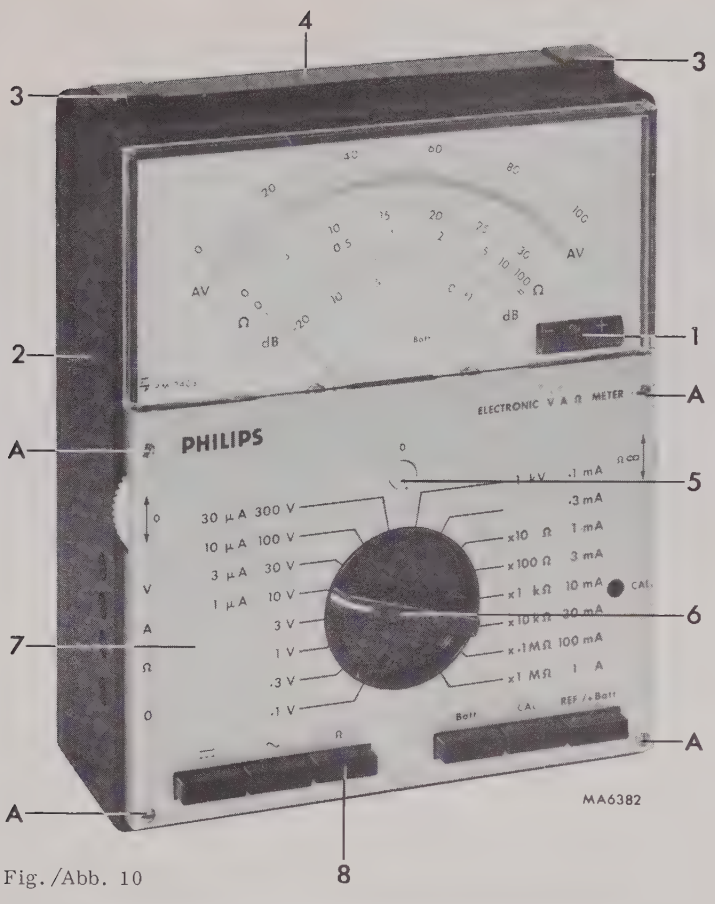


Fig./Abb. 10

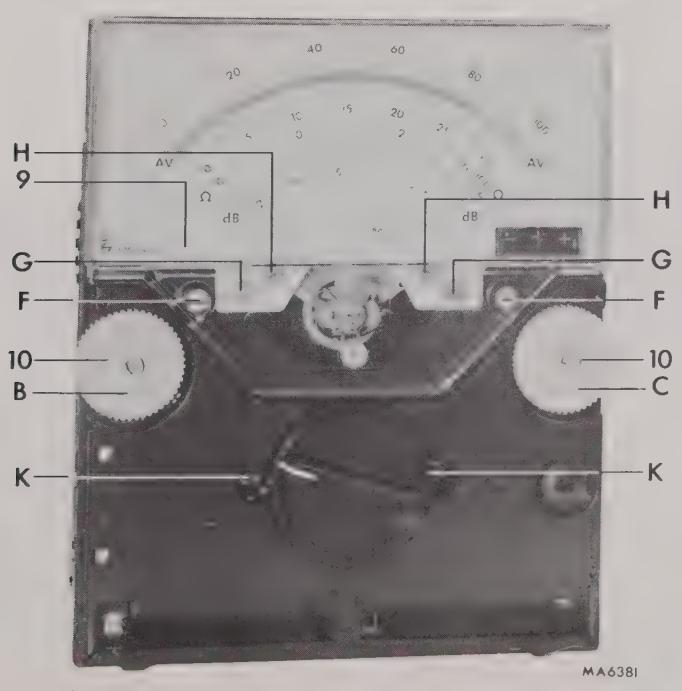


Fig./Abb. 11

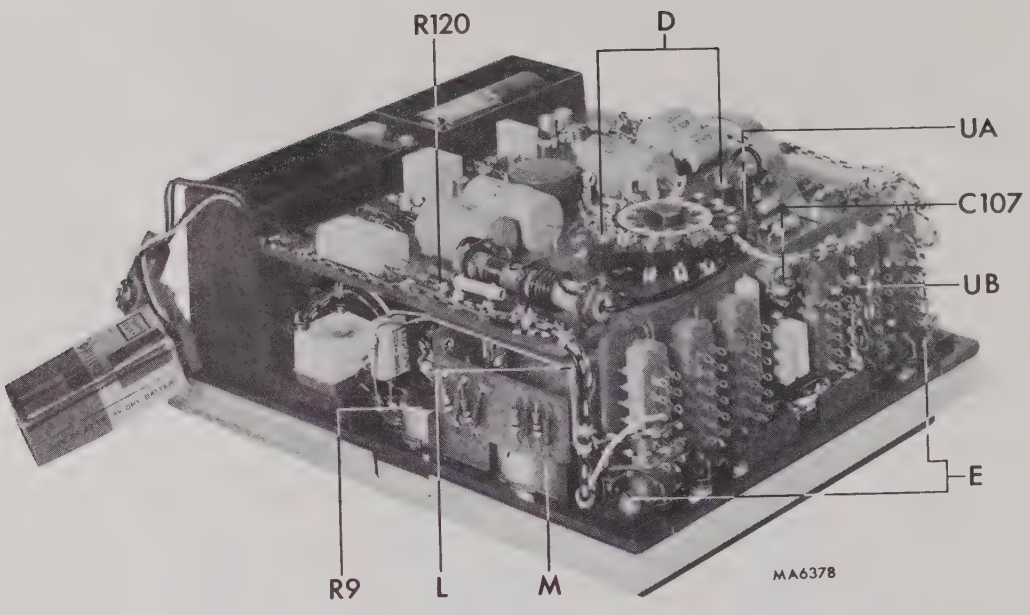


Fig./Abb. 12

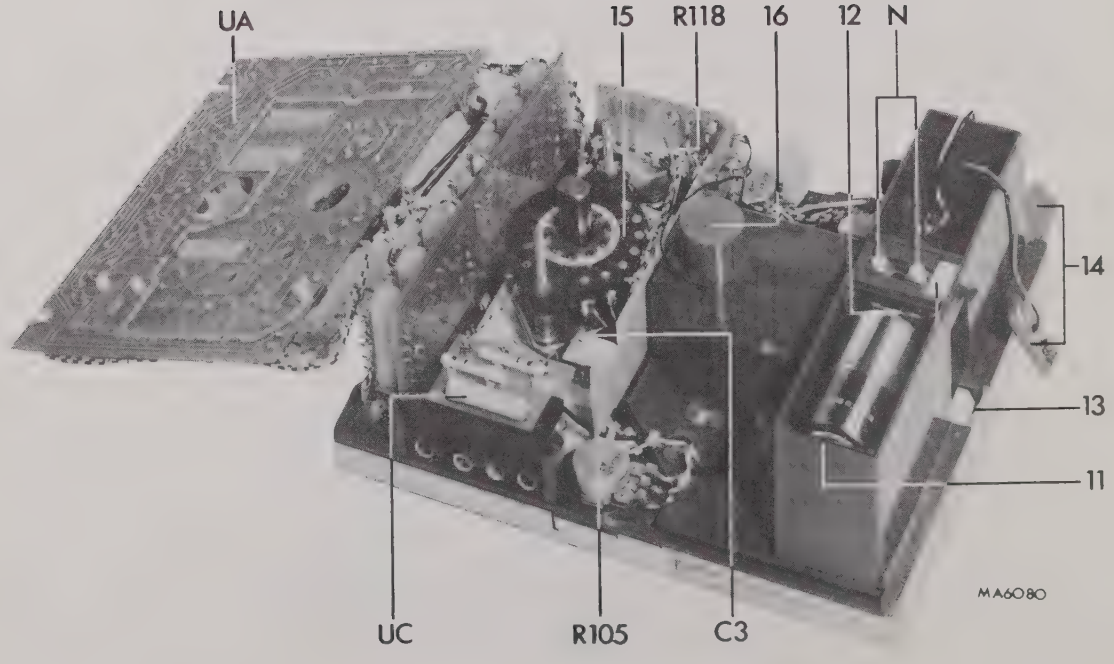


Fig./Abb. 13

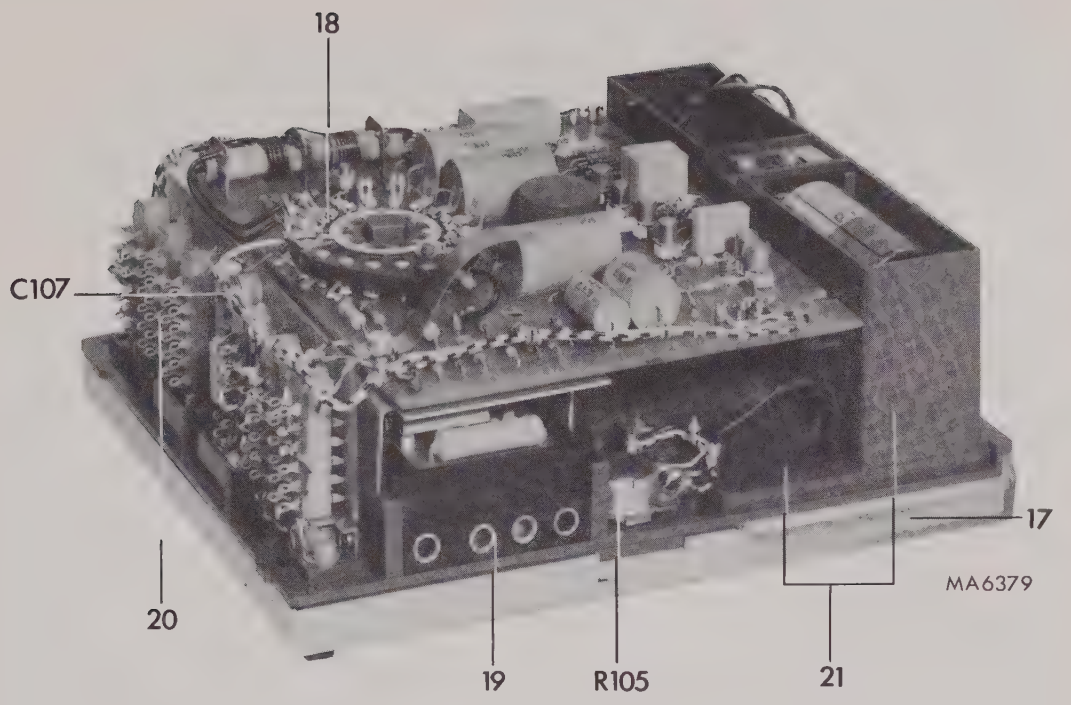


Fig./Abb. 14

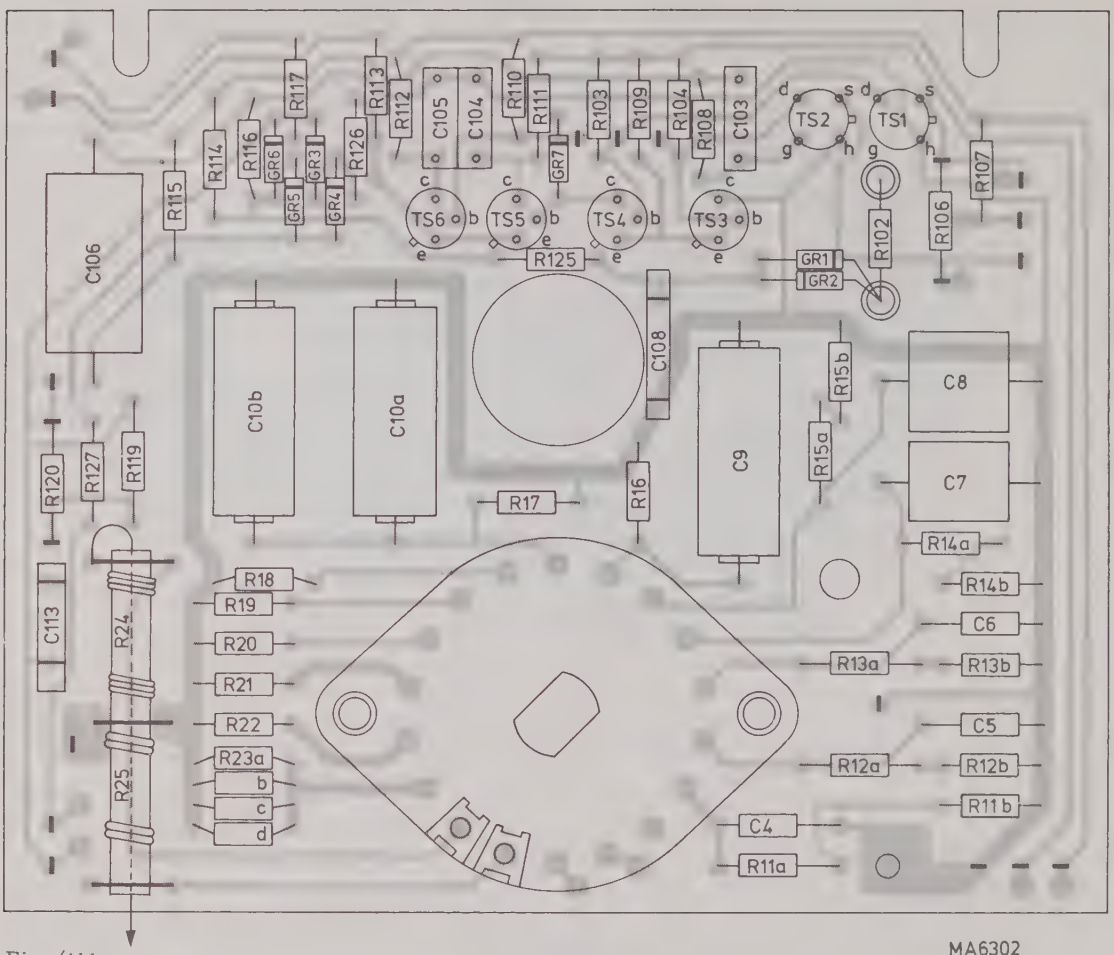


Fig. /Abb. 15

MA6302

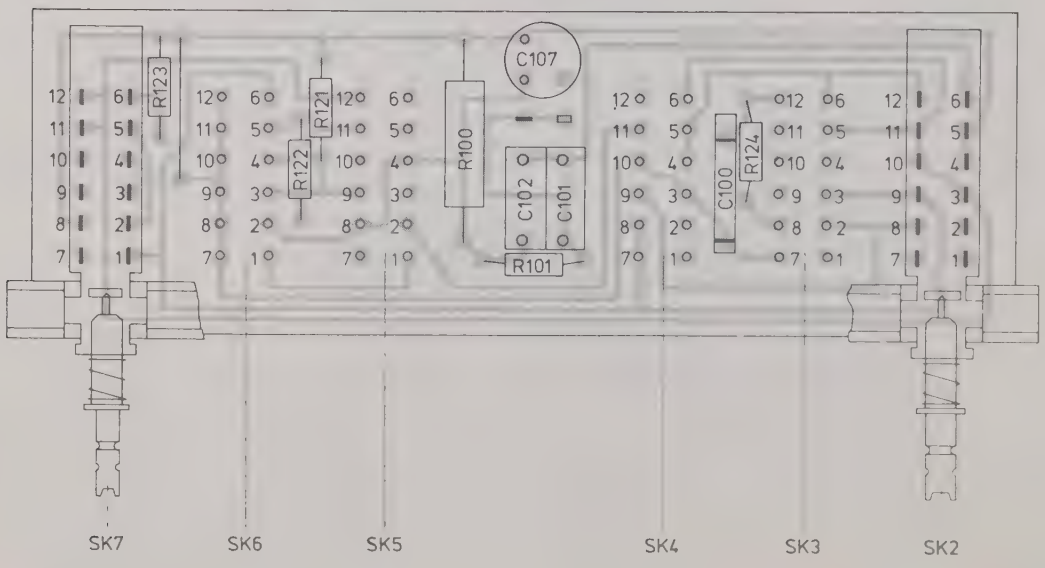


Fig. /Abb. 16

MA6301

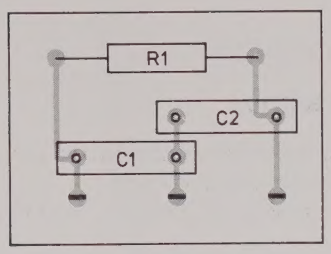


Fig./Abb. 17

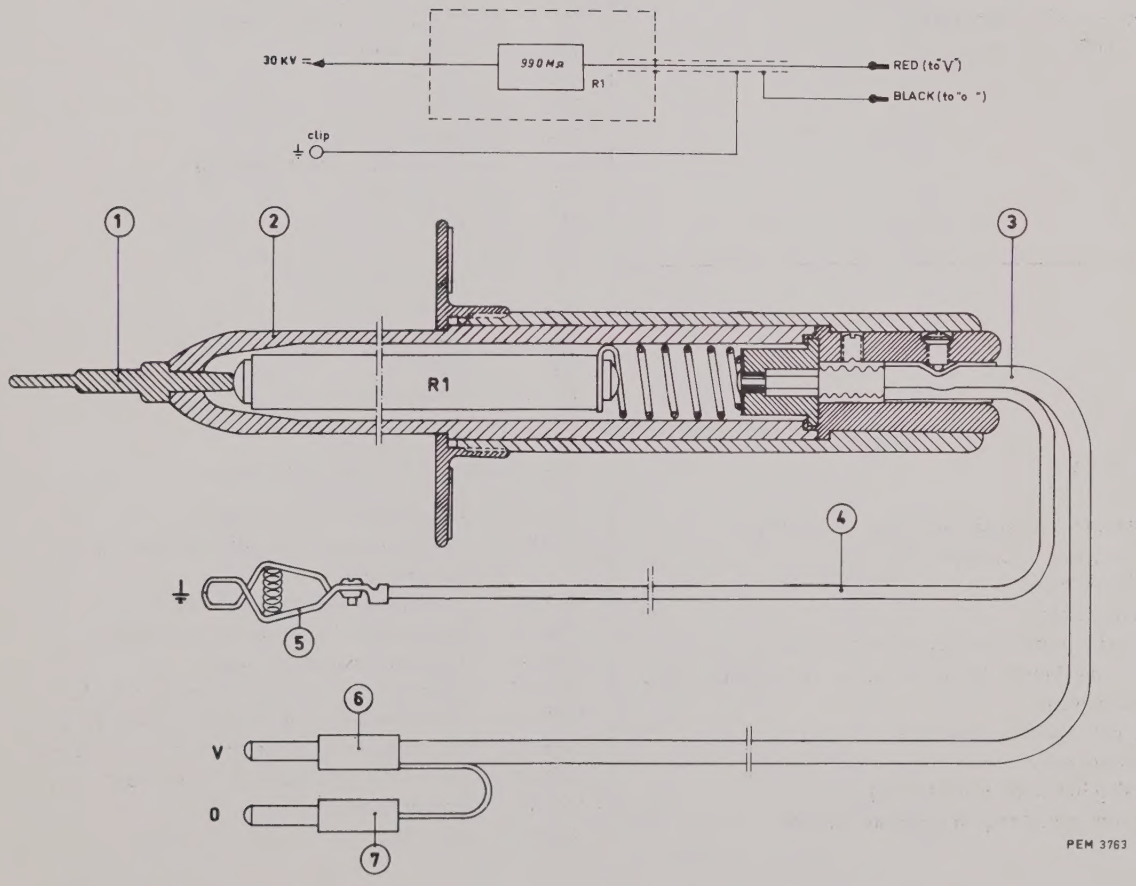


Fig./Abb. 18

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

□□□

Unit number
e.g. 000A or 0001 (for unit A or 1; not 00UA or 00U1)

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

CATEGORY

□

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

COMPONENT/SEQUENCE NUMBER

□□□□

Enter the identification as used in the circuit diagram, e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
R0....	Resistor, potentiometer
C0....	Capacitor, variable capacitor
B0....	Tube, valve
LA....	Lamp
VL...	Fuse
SK....	Switch
BU....	Connector, socket, terminal
T0....	Transformer
L0....	Coil
X0....	Crystal
CB....	Circuit block
RE....	Relay
ME....	Meter, indicator
BA....	Battery
TR....	Chopper

Parts not identified in the circuit diagram:

990000	Unknown/Not applicable
990001	Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002	Knob (incl. dial knob, cap, etc.)
990003	Probe (only if attached to instrument)
990004	Leads and associated plugs
990005	Holder (valve, transistor, fuse, board, etc.)
990006	Complete unit (p.w. board, h.t. unit, etc.)
990007	Accessory (only those without type number)
990008	Documentation (manual, supplement, etc.)
990009	Foreign object
990099	Miscellaneous

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224 DUFFY AVENUE
HICKSVILLE, NEW YORK 11802